Acquiring Micro-Resistivity Borehole Images in Deviated and Horizontal Wells Using Shuttle Deployed Memory Tools

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Summary

Borehole images have broad application in geological, petrophysical and geomechanical studies. The advent of the small-diameter memory micro-resistivity imaging tool improves operational efficiency in a broad range of well types. It extends the availability of high-quality images to slim and / or high dogleg wells, and reduces acquisition risk in high angle wells and wells drilled through formations prone to borehole bridging. In spite of the tool's small size and weight, its novel design provides coverage and image quality that matches or exceeds that of previous generation imaging tools. It is deployed with or without a wireline, and is not constrained by wireline data transmission rates because data are recorded to internal memory. Deploying the tool inside drill pipe on the well shuttle facilitates access into highly deviated wells and past bad hole conditions without compromising borehole coverage.

Introduction

From a production point of view, most reservoirs have anisotropic behavior. Heterogeneities induced by sedimentological, structural and diagenetic processes are among the causes of such anisotropy. Optimizing reservoir recovery requires reliable models of sedimentary rocks. Capturing those heterogeneities is crucial for precise geological and reservoir modelling. Borehole imaging is regarded as a powerful tool to study the depositional setting of sedimentary rocks, delineate reservoir characteristics, derive rock properties and assess their potential to produce hydrocarbons.

Finding fractures in deep and tight rocks has become a high priority among explorationists and developers around the world. Recent discoveries have shown that fractures can play an important role in the productivity of low permeability plays such as coal bed methane or shale gas. This is because these fractures form an interface with the rock matrix which is many times greater than that provided by the borehole. The only logging technology with the resolution to detect and identify these small features within the reservoirs is borehole imaging, where details 2mm and smaller can be visualized.

Theory and/or Method

A number of deviated wells were logged In the Western Canadian Sedimentary Basin using memory borehole imaging tools deployed from inside drill pipe without a conventional wireline. The tools were housed inside a special drill collar while running in the hole, allowing rotation and circulation. Once at bottom, the tools were deployed using a messenger system and pressure pulses. The tools recorded micro-resistivity data to memory as the drill pipe was then tripped to surface. In all wells data was recovered, processed, and interpreted using software specially developed for this new memory based technology. Quantitative image analysis was aided by computing button resistivity values directly in the pad with a high dynamic range, resulting in clear images over a broad range of lithologies and resistivities. A new proprietary speed-correction algorithm improved pad-to-pad alignment accuracy and virtually eliminated the residual manual editing that was a feature of previous algorithms.

Examples

These concepts and techniques will be illustrated with examples from the Upper Mannville CBM play in south central Alberta.

Conclusions

The resulting images were the equal of electrical borehole images obtained using conventional wireline deployment, and were easily integrated into the operating companies' workflow. The results indicate that electrical borehole images obtained using memory tools housed inside drill pipe reduced risk and uncertainty when compared to conventional tool push techniques.

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